

What is claimed is :

- 1 1. A reduced size GPS conical shaped microstrip antenna
- 2 array comprising:
 - 3 (a) a first dielectric layer
 - 4 (b) a plurality of square shaped antenna elements mounted
 - 5 on an upper surface of said first dielectric layer, said
 - 6 antenna elements being aligned with one another and
 - 7 fabricated from copper, said antenna elements being
 - 8 adapted to receive an RF carrier signal containing GPS
 - 9 (Global Positioning System) data;
 - 10 (d) a first copper cross hatch pattern mounted on the
 - 11 upper surface of said first dielectric layer around a
 - 12 periphery for each of said antenna elements wherein a gap
 - 13 forms between the periphery for each of said antenna
 - 14 elements and said copper cross hatch pattern;
 - 15 (e) an antenna feed network mounted on a bottom surface of
 - 16 said first dielectric layer, said antenna feed network
 - 17 having a plurality of branch transmission lines
 - 18 electrically connected to each of said antenna elements,
 - 19 each of said branch transmission lines including a pair of
 - 20 probes positioned perpendicular to one another underneath
 - 21 one antenna element of said plurality of antenna elements,
 - 22 one of said pair of probes for each of said branch

23 transmission lines having a length substantially greater
24 than the other of said pair of probes for each of said
25 branch transmission lines to provide for a ninety degree
26 relative phase shift between RF signals transmitted
27 through said pair of probes of each of said pair of branch
28 transmission lines;

29 (f) a second copper cross hatch pattern mounted on the
30 bottom surface of said first dielectric substrate in
31 proximity to said antenna feed network;

32 (g) a second dielectric layer positioned below said first
33 dielectric layer in alignment with said first dielectric
34 layer;

35 (h) a third copper cross hatch pattern mounted on an upper
36 surface of said second dielectric layer, said third copper
37 cross hatch pattern being in alignment and substantially
38 identical to said second cross hatch pattern; and

39 (i) a solid copper ground plane affixed to a bottom
40 surface of said first dielectric layer.

1 2. The reduced size GPS conical shaped microstrip antenna
2 array of claim 1 further comprising a bonding film positioned
3 between said first dielectric layer and said second dielectric
4 layer, said bonding film securing the bottom surface of said

5 first dielectric layer to the upper surface of said second
6 dielectric layer.

1 3. The reduced size GPS conical shaped microstrip antenna
2 array of claim 1 further comprising:

3 (a) a third dielectric layer positioned above said first
4 dielectric layer in alignment with said first dielectric
5 layer; and

6 (b) a bonding film positioned between said first
7 dielectric layer and said third dielectric layer, said
8 bonding film securing the upper surface of said first
9 dielectric layer to a bottom surface of said third
10 dielectric layer.

1 4. The reduced size GPS conical shaped microstrip antenna
2 array of claim 3 wherein said third dielectric layer is a cover
3 for said reduced size GPS conical shaped microstrip antenna
4 array.

1 5. The reduced size GPS conical shaped microstrip antenna
2 array of claim 1 wherein said plurality of antenna elements
3 comprises first, second, third and fourth antenna elements for
4 receiving said RF carrier signal containing said GPS data, each

5 of said first, second, third and fourth antenna elements having
6 an opening located at the center thereof, the opening in each
7 of said first, second, third and fourth antenna elements having
8 a diameter of approximately 0.024 of an inch to reduce the size
9 of said conical shaped microstrip antenna array.

1 6. The reduced size GPS conical shaped microstrip antenna
2 array of claim 1 wherein each of said first, second and third
3 copper cross hatch patterns comprises a plurality of 0.02 inch
4 wide copper traces spaced apart by a 0.05 inch rectangular
5 shaped opening.

1 7. The reduced size GPS conical shaped microstrip antenna
2 array of claim 1 further comprising a plurality of copper
3 plated through holes positioned within said first dielectric
4 layer and a plurality of plated through holes positioned within
5 said second dielectric layer, the copper plated through holes
6 of said first dielectric layer aligning with the copper plated
7 through holes of said second dielectric layer, the copper
8 plated through holes of said first dielectric layer being EM
9 coupled to the copper plated through holes of said second
10 dielectric layer, wherein the copper plated through holes

11 of said first dielectric layer and the copper plated through
12 holes of said second dielectric layer prevent said antenna feed
13 network from becoming electrically coupled to said antenna
14 elements.

1 8. The reduced size GPS conical shaped microstrip antenna
2 array of claim 7 wherein the copper plated through holes
3 of said first dielectric layer and the copper plated through
4 holes of said second dielectric layer each comprises two
5 hundred five copper plated through holes.

1 9. The reduced size GPS conical shaped microstrip antenna
2 array of claim 1 wherein said first dielectric layer and said
3 second dielectric layer each have an approximate thickness of
4 0.030 of an inch, and said third dielectric layer has an
5 approximate thickness of 0.062 of an inch.

1 10. A reduced size GPS conical shaped microstrip antenna
2 array comprising:
3 (a) a first dielectric layer
4 (b) a plurality of square shaped antenna elements mounted

5 on an upper surface of said first dielectric layer, said
6 antenna elements being aligned with one another and
7 fabricated from copper, said antenna elements being
8 adapted to receive an RF carrier signal containing GPS
9 (Global Positioning System) data;

10 (d) a first copper cross hatch pattern mounted on the
11 upper surface of said first dielectric layer around a
12 periphery for each of said antenna elements wherein a gap
13 forms between the periphery for each of said antenna
14 elements and said copper cross hatch pattern;

15 (e) an antenna feed network mounted on a bottom surface of
16 said first dielectric layer, said antenna feed network
17 having a plurality of branch transmission lines
18 electrically connected to each of said antenna elements,
19 each of said branch transmission lines including a pair of
20 probes positioned perpendicular to one another underneath
21 one antenna element of said plurality of antenna elements,
22 one of said pair of probes for each of said branch
23 transmission lines having a length substantially greater
24 than the other of said pair of probes for each of said
25 branch transmission lines to provide for a ninety degree
26 relative phase shift between RF signals transmitted
27 through said pair of probes of each of said pair of branch

28 transmission lines, said ninety degree relative phase
29 shift providing for right hand circular polarization for
30 plurality of antenna elements of said GPS conical shaped
31 microstrip antenna array;

32 (f) a second copper cross hatch pattern mounted on the
33 bottom surface of said first dielectric substrate in
34 proximity to said antenna feed network;

35 (g) a second dielectric layer positioned below said first
36 dielectric layer in alignment with said first dielectric
37 layer;

38 (h) a third copper cross hatch pattern mounted on an upper
39 surface of said second dielectric layer, said third copper
40 cross hatch pattern being in alignment and substantially
41 identical to said second cross hatch pattern; and

42 (i) a solid copper ground plane affixed to a bottom
43 surface of said first dielectric layer;

44 (j) a first bonding film positioned between said first
45 dielectric layer and said second dielectric layer, said
46 first bonding film securing the bottom surface of said
47 first dielectric layer to the upper surface of said second
48 dielectric layer;

49 (k) a third dielectric layer positioned above said first

50 dielectric layer in alignment with said first dielectric
51 layer; and

52 (1) a second bonding film positioned between said first
53 dielectric layer and said third dielectric layer, said
54 second bonding film securing the upper surface of said
55 first dielectric layer to a bottom surface of said third
56 dielectric layer wherein said third dielectric layer is a
57 cover for said reduced size GPS conical shaped microstrip
58 antenna array.

1 11. The reduced size GPS conical shaped microstrip antenna
2 array of claim 10 wherein said first dielectric layer and said
3 second dielectric layer each have an approximate thickness of
4 0.030 of an inch, and said third dielectric layer has an
5 approximate thickness of 0.062 of an inch.

1 12. The reduced size GPS conical shaped microstrip antenna
2 array of claim 10 wherein said first bonding film and said
3 second bonding film each have an approximate thickness of 0.002
4 of an inch.

1 13. The reduced size GPS conical shaped microstrip antenna
2 array of claim 10 wherein said third dielectric layer is a

3 cover for said reduced size GPS conical shaped microstrip
4 antenna array.

1 14. The reduced size GPS conical shaped microstrip antenna
2 array of claim 10 wherein said plurality of antenna elements
3 comprises first, second, third and fourth antenna elements for
4 receiving said RF carrier signal containing said GPS data,
5 each of said first, second, third and fourth antenna elements
6 having an opening located at the center thereof, the opening in
7 each of said first, second, third and fourth antenna elements
8 having a diameter of approximately 0.024 of an inch to reduce
9 the size of said conical shaped microstrip antenna array.

1 15. The reduced size GPS conical shaped microstrip antenna
2 array of claim 10 wherein each of said first, second and third
3 copper cross hatch patterns comprises a plurality of 0.02 inch
4 wide copper traces spaced apart by a 0.05 inch rectangular
5 shaped opening.

1 16. The reduced size GPS conical shaped microstrip antenna
2 array of claim 10 further comprising a plurality of copper
3 plated through holes positioned within said first dielectric

4 layer and a plurality of plated through holes positioned within
5 said second dielectric layer, the copper plated through holes
6 of said first dielectric layer aligning with the copper plated
7 through holes of said second dielectric layer, the copper
8 plated through holes of said first dielectric layer being EM
9 coupled to the copper plated through holes of said second
10 dielectric layer, wherein the copper plated through holes
11 of said first dielectric layer and the copper plated through
12 holes of said second dielectric layer prevent said antenna feed
13 network from becoming electrically coupled to said antenna
14 elements.

1 17. The reduced size GPS conical shaped microstrip antenna
2 array of claim 16 wherein the copper plated through holes
3 of said first dielectric layer and the copper plated through
4 holes of said second dielectric layer each comprises two
5 hundred five copper plated through holes.

1 18. A reduced size GPS conical shaped microstrip antenna
2 array comprising:
3 (a) a first dielectric layer

4 (b) a plurality of square shaped antenna elements mounted
5 on an upper surface of said first dielectric layer, said
6 antenna elements being aligned with one another and
7 fabricated from copper, said antenna elements being
8 adapted to receive an RF carrier signal containing GPS
9 (Global Positioning System) data;

10 (d) a first copper cross hatch pattern mounted on the
11 upper surface of said first dielectric layer around a
12 periphery for each of said antenna elements wherein a gap
13 forms between the periphery for each of said antenna
14 elements and said copper cross hatch pattern;

15 (e) an antenna feed network mounted on a bottom surface of
16 said first dielectric layer, said antenna feed network
17 having a plurality of branch transmission lines
18 electrically connected to each of said antenna elements,
19 each of said branch transmission lines including a pair of
20 probes positioned perpendicular to one another underneath
21 one antenna element of said plurality of antenna elements,
22 one of said pair of probes for each of said branch
23 transmission lines having a length substantially greater
24 than the other of said pair of probes for each of said
25 branch transmission lines to provide for a ninety degree
26 relative phase shift between RF signals transmitted

27 through said pair of probes of each of said pair of branch
28 transmission lines, said ninety degree relative phase
29 shift providing for right hand circular polarization for
30 plurality of antenna elements of said GPS conical shaped
31 microstrip antenna array;

32 (f) a second copper cross hatch pattern mounted on the
33 bottom surface of said first dielectric substrate in
34 proximity to said antenna feed network;

35 (g) a second dielectric layer positioned below said first
36 dielectric layer in alignment with said first dielectric
37 layer;

38 (h) a third copper cross hatch pattern mounted on an upper
39 surface of said second dielectric layer, said third copper
40 cross hatch pattern being in alignment and substantially
41 identical to said second cross hatch pattern; and

42 (i) a solid copper ground plane affixed to a bottom
43 surface of said first dielectric layer;

44 (j) a first bonding film positioned between said first
45 dielectric layer and said second dielectric layer, said
46 first bonding film securing the bottom surface of said
47 first dielectric layer to the upper surface of said second
48 dielectric layer;

49 (k) a third dielectric layer positioned above said first

50 dielectric layer in alignment with said first dielectric
51 layer;

52 (l) a second bonding film positioned between said first
53 dielectric layer and said third dielectric layer, said
54 second bonding film securing the upper surface of said
55 first dielectric layer to a bottom surface of said third
56 dielectric layer wherein said third dielectric layer is a
57 cover for said reduced size GPS conical shaped microstrip
58 antenna array;

59 (m) said first dielectric layer and said second dielectric
60 layer each have an approximate thickness of 0.030 of an
61 inch, said third dielectric layer has an approximate
62 thickness of 0.062 of an inch, and said first bonding film
63 and said second bonding film each have an approximate
64 thickness of 0.002 of an inch; and

65 (n) a plurality of copper plated through holes positioned
66 within said first dielectric layer and a plurality of
67 plated through holes positioned within said second
68 dielectric layer, the copper plated through holes of said
69 first dielectric layer aligning with the copper plated
70 through holes of said second dielectric layer, the copper
71 plated through holes of said first dielectric layer being
72 EM coupled to the copper plated through holes of said

73 second dielectric layer, wherein the copper plated through
74 holes of said first dielectric layer and the copper plated
75 through holes of said second dielectric layer prevent said
76 antenna feed network from becoming electrically coupled to
77 said antenna elements.

1 19. The reduced size GPS conical shaped microstrip antenna
2 array of claim 18 wherein said plurality of antenna elements
3 comprises first, second, third and fourth antenna elements for
4 receiving said RF carrier signal containing said GPS data,
5 each of said first, second, third and fourth antenna elements
6 having an opening located at the center thereof, the opening in
7 each of said first, second, third and fourth antenna elements
8 having a diameter of approximately 0.024 of an inch to reduce
9 the size of said conical shaped microstrip antenna array.

1 20. The reduced size GPS conical shaped microstrip antenna
2 array of claim 18 wherein each of said first, second and third
3 copper cross hatch patterns comprises a plurality of 0.02 inch
4 wide copper traces spaced apart by a 0.05 inch rectangular
5 shaped opening.

1 21. The reduced size GPS conical shaped microstrip antenna
2 array of claim 18 wherein the copper plated through holes
3 of said first dielectric layer and the copper plated through
4 holes of said second dielectric layer each comprises two
5 hundred five copper plated through holes.